

WHAT IS CLAIMED IS:

1. A toilet cover opening/closing device for a toilet unit having a toilet cover comprising:

a rotary shaft for moving said toilet cover; and

a driving means for rotating said rotary shaft to provide a rotational motion to said toilet cover from an inclined starting position wherein said toilet cover starts rotating in a closing direction under its own weight, said driving means further comprising:

a motor that is rotatable both clockwise and counterclockwise;

a driving member that is connected to the output shaft end of said motor;

a slave member that is connected to said rotary shaft end; and

a switching mechanism mechanically connecting or disconnecting said driving member from said slave member;

wherein, when said motor rotates clockwise to move said toilet cover from a fully opened position to the inclined starting position, said switching mechanism allows said slave member to move in response to said driving member; after said toilet cover reaches said inclined starting position, the mechanical linkage between said driving member and said slave member is released such that said slave member moves by self-weight initiated rotary motion of said toilet cover independent of said driving member while said driving member returns to its fully opened position in said toilet cover independent of said slave member taking advantage of said motor's reversed spin.

2. A toilet cover opening/closing device as set forth in Claim 1 wherein, in said switching mechanism, said driving member pushes said slave member to move said toilet cover from said fully opened position to said inclined starting position, wherein said slave member and said driving member do not interfere with each other as long as said toilet cover's self-weight initiates the motion of

said slave member defined by said inclined starting position and said fully closed position.

3. A toilet cover opening/closing device as set forth in Claim 1 wherein said switching mechanism has a structure in which a groove is provided on said driving member in such a manner that a part of said slave member makes a relative linear motion therein to move in response to said driving member when said toilet cover moves from said fully opened position to said inclined starting position;

wherein the shape and length of said groove from said one edge to the other edge is set so as to cause the following:

said motor's reversed spin provides said slave member a rotational motion independent of said driving member after said toilet cover rotates from said fully opened position to said inclined starting position; and

said driving member is capable of returning to its original position independent of said slave member.

4. The toilet cover opening/closing device as set forth in Claim 1 wherein said toilet cover further comprises a shock absorber for applying a resisting force to the self-weight initiated rotational motion exercised in the closing direction thereby slowing down the speed of said self-weight initiated rotational motion that occurs between said inclined starting position and said fully closed position.

5. The toilet cover opening/closing device as set forth in Claim 1 wherein said motor is a stepping motor.

6. The toilet cover opening/closing device as set forth in Claim 1 wherein said toilet cover further comprises a stopper that mechanically defines the original position and the end position of said driving member, which is in line with the rotational motion of said driving member that occurs between said fully opened position and said inclined starting position.

7. A toilet cover closing device for a toilet unit having a toilet cover, the toilet cover having an open position, a partially closed position and a closed position, the toilet cover closing device comprising:

a slave member connected to the toilet cover;

a motor rotatable in a first direction and a second direction opposite to the first direction; and

a switching mechanism operable to mechanically connect or disconnect the motor from the slave member;

wherein, when the motor rotates in the first direction to move the toilet cover from the open position to the partially closed position, the switching mechanism allows the slave member to move in response to rotation of the motor; and

after the toilet cover reaches the partially closed position, the mechanical link between the slave member and the motor provided by the switching mechanism is released such that the toilet cover falls freely under its own weight to the closed position independent of the motor.

8. The toilet cover closing device according to claim 7, further comprising a driving member coupled between the motor and the switching mechanism and operable to move the slave member, wherein the motor rotates in the second direction to return the driving member to a position corresponding to the open position of the toilet cover such that during opening of the toilet cover, the slave member is mechanically disconnected from the driving member to reduce the amount of force required to open the toilet cover.

9. The toilet cover closing device according to claim 7, further comprising a driving member coupled between the motor and the switching mechanism and operable to move the slave member, wherein the motor rotates in the second direction to return the driving member to a position corresponding to the open position of the toilet cover while the toilet cover falls freely under its own weight to the closed position.

10. The toilet cover closing device according to claim 9, further comprising a sensor that detects a predetermined position of the toilet cover between the partially closed position and the closed position, wherein the motor rotates in the second direction to return the driving member upon detection of the predetermined position by the sensor.

11. A toilet cover closing device according to claim 9, wherein:

the switching mechanism includes a groove provided on the driving member such that the slave member moves in response to the driving member when the toilet cover moves from the open position to the partially closed position; and

the groove from one edge to the other edge is shaped and sized to cause the following:

rotation of the motor in the second direction provides the slave member with a rotational motion which is independent of the driving member while the toilet cover falls freely under its own weight to the closed position; and

the driving member is capable of returning to a position corresponding to the open position of the toilet cover independent of the slave member.

12. The toilet cover closing device according to claim 9, further comprising a stopper that mechanically defines the original position and the end position of the driving member, which is in line with the rotational motion of the driving member that occurs between the open position and the partially closed position.

13. A toilet cover closing device for a toilet unit having a toilet cover, the toilet cover having an open position, a partially closed position and a closed position, the toilet cover closing device comprising:

a rotary shaft connected to the toilet cover;

a slave member connected to the rotary shaft to rotate the rotary shaft;

a motor rotatable in a first direction and a second direction opposite to the first direction;

a driving member operable to be driven by the motor; and  
a switching mechanism operable to mechanically connect or disconnect the driving member from the slave member;

wherein the motor rotates in the first direction to drive the driving member and the slave member to move the toilet cover from the open position to the partially closed position; and

after the toilet cover reaches the partially closed position, the mechanical link provided by the switching mechanism between the driving member and the slave member is released to allow the toilet cover to fall freely under its own weight to the closed position independent of the driving member.

14. The toilet cover closing device according to claim 13, further comprising a driving member coupled between the motor and the switching mechanism and operable to move the slave member, wherein the motor rotates in the second direction to return the driving member to a position corresponding to the open position of the toilet cover while the toilet cover falls freely under its own weight to the closed position.

15. The toilet cover closing device according to claim 13, further comprising a sensor that detects a predetermined position of the toilet cover between the partially closed position and the closed position, wherein the motor rotates in the second direction to return the driving member upon detection of the predetermined position by the sensor.